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1. An apparatus for ultrasonic energy deposition in body tissue comprising:
an array of elements having at least two different sizes, at least one element being
aperiodically spaced with the respect to other elements whereby excitation of
said elements produces a beam of ultrasonic energy having reduced grating
lobes.

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2. The apparatus of claim 1 wherein at least one element among all elements having
the same size is aperiodically spaced with the respect to other elements.

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3. The apparatus of claim 1 wherein said elements include a first element size and a
second element size, said first element size being at least five percent smaller than said
second element size.

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4. The apparatus of claim 1 wherein said elements include a first element size and a
second element size, a top surface of an element of said first element size being at least five
percent smaller than a top surface of an element of said second element size.

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5. The apparatus of claim 2 wherein said at least two elements are aperiodically spaced
with respect to other elements.

6. The apparatus of claim 3 wherein at least one element of said first element size and
at least one element of said second element size is aperiodically spaced with the respect to
other elements.

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7. The apparatus of claim 3 wherein at least ten percent of said elements are
aperiodically spaced with the respect to other elements.

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8. The apparatus of claim 3 wherein at least twenty-five percent of said elements are
aperiodically spaced with the respect to other elements.

9. The apparatus of claim 3 wherein approximately one half of said elements are aperiodically spaced with respect to other elements.
- 5 10. The apparatus of claim 1 wherein said ultrasonic energy emitted from said elements has a frequency of approximately 0.1 to 100 MHz.
- 10 11. The apparatus of claim 3 wherein an average center of mass-to-center of mass spacing of adjacent elements is greater than a half of a wavelength of said ultrasonic energy.
- 15 12. The apparatus of claims 3 wherein said array includes a single row of said elements.
- 20 13. The apparatus of claims 3 wherein said array is a two dimensional arrangement of said elements.
- 25 14. The apparatus of claim 3 wherein said array is two dimensional and includes at least two rows of said elements.
- 30 15. The apparatus of claim 3 wherein said array is a three dimensional arrangement of said elements.
16. The apparatus of claims 3 wherein said arrangement is three dimensional and includes at least two rows of said elements.
17. The apparatus of claim 3 further comprising a spacer located between adjacent elements.
18. The apparatus of claim 17 wherein said spacer size is uniform such that edges of said elements are evenly spaced from edges of adjacent elements.

19. The apparatus of claim 17 wherein said spacer size is non-uniform such that edges of said elements are non-evenly spaced from edges of adjacent elements.

5 20. The apparatus of claim 3 wherein an arrangement of said elements in said array is derived from a method of optimized random distribution.

10 21. The apparatus of claim 20 wherein said method of optimized random distribution comprises steps of deriving a cost function and calculating a value of said cost function for a plurality of random element sizes and positions, thereby obtaining a random distribution of cost function values from which to optimize said arrangement of said elements.

22. The apparatus of claim 21 wherein said cost function includes a quotient of a maximum focusing power and a maximum corresponding grating lobe power.

23. The apparatus of claim 1 further comprising an excitation means coupled to said plurality of elements for providing said elements with electrical excitations.

20 24. The apparatus of claim 23 further comprising a phase shifting means coupled to said excitation means for providing said elements with electrical excitations having adjustable phases in order to apply said beam to a region of said body tissue.

25 25. The apparatus of claim 24 wherein said phase shifting means steers said beam through an angle up to ninety degrees.

26. The apparatus of claim 25 wherein said phase shifting means steers said beam to at least two distinct focal positions within said region of body tissue.

30 27. The apparatus of claim 26 wherein said excitation means includes an apodization means for independently controlling an amplitude, a phase and a frequency of said electrical excitations provided to each element.

28. The apparatus of claim 27 wherein said apodization means includes a profile optimization method for controlling said beam to provide a substantially uniform temperature profile within said region of body tissue.

5 29. The apparatus of claim 28 wherein said profile optimization method includes steps of selecting foci weighing factors and calculating a cost function for said foci weighing factors.

10 30. The apparatus of claim 24 further comprising an magnetic resonance imaging means for providing an image of said body tissue coupled to said excitation means and said phase shifting means whereby said excitation means and said phase shifting means are controllable in response to said image.

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31. An apparatus for producing localized energy deposition in body tissue comprising: a plurality of radiating elements each having a center of mass and at least one of said elements being oriented such that a center of mass-to-center of mass distance between said at least one element and adjacent elements is irregular.

20 32. An apparatus for producing localized energy deposition in body tissue comprising: a plurality of radiating elements each element having one of two or more different sizes; and
an array of said plurality of elements having uniformly sized spacers between adjacent elements wherein among elements of substantially the same size at least one of said same-size elements is aperiodically spaced.

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